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A Letter written by D. Lucas Hodgson, Physician at Newcastle, containing some Observations made by him of a Subterranean Fire in a Coal-mine near that City.

SIR, Newcastle May the 15. 1676.

I Had long since returned my humble thanks to the *Royal Society* for their candid acceptance of my paper; and particularly to you for your most obliging Letter, had I not thought a farther account of what I have observed in the fire, would be more acceptable to that Illustrious Body; particularly to the Honourable Mr. Boyle, for whose ingenious *Queries* I give him most hearty thanks, accounting my self happy, that by this occasion any thing of mine should come under the consideration of so worthy a person. To the end therefore that I might return more than words, (as my occasions would permit) I have several times visited the fire, diligently observing what might occur at the various places of its eruption, whereby I am in some measure enabled to give a particular Answer to his desire in that matter.

Qu. 1. *Whether the vents of the Subterranean fire are not subject to paroxysms or great fits of eruption at times?*

2. *Whether those notable eruptions do happen regularly at any set times, or fortuitously; and if at set times, whether these times be the beginnings, middle, or endings, of any of the four seasons of the year?*

3. *Whether from the eruption, the silence or suppression, or the smoaking of the Subterranean fires, any certain or probable prognostick can be made of changes of weather, or of Meteors; and if they can, how long they are wont to precede the things they presage?*

Ans. This Fire keeping no analogy with other Vulcanio's in any of the particulars mentioned in these three quæries, I thought fit to answer them altogether to avoid prolixity, seeing all I can observe is, that it increaseth or decreaseth according to the subject

* The upper Seam of the Coal, next exposed to the Air.

it feedeth on; which is for the most part a *Day-coal**, as they call it, so that you may light a candle at it in some places, in other places it is some fathoms deep, according as the Day-coal heightens or deepens; in other things it is no ways instructive.

4. *Whether the Marcasites that are found in or about the Burning Coalpits be of such a nature, as being laid on heaps small or great, and drench't with rain, or other water, they will of themselves actually take fire?*

Ans. I remember that Dr. Power, in his book of *Microscopical Obser-*

Observations pag. 62, takes notice of such an accident ; but I do not understand that any with us have observed the like.

5. *Whether in those Coalmines they find any actual Sulphur in its proper form, that may safely be concluded not to have been produced by the action of the fire upon the Marcasites ?*

Ans. I never saw any, nor any man else that I can hear of.

6. *Whether the Sal armoniac be found any where thereabouts, save in those places where an actual fire hath come, and also which have been accessible to the Air ?*

Ans. No Sal armoniac, nor any thing like it to be found, except at the fire.

7. *Whether at the mouth of these Igneducts, where flowers of Sulphur and Sal armoniac are found, there do issue forth any steams or exhalations that may be rather lookt upon as the productions of actually kindled Sulphur, than of Sulphur barely sublimed ? Which may be tried by holding over the vent Red rose leaves, or any of those other bodies that are wont to be blanch't, or made pale by the fume of burning Sulphur ?*

Ans. There being such a mixture of the steams of Sal armoniac and Sulphur rising together in most places, it is hard to distinguish them ; for though the flowers of Brimstone seem to rise first, yet there is commonly a crust of Sal armoniac under them ; as for the Experiment, I shall try it as soon as any Roses are blown.

8. *Whether the milky substance that is mentioned in the paper, be ever found among Metallin oars, or meerly among stones ; and whether it be found so surrounded every way with stone, that no channel or other visible passage can be found, at which it may probably be suspected to have entred into the Cavity wherein it was lodged ?*

Ans. The Milky substance is found no where but where the Sal armoniac and Sulphur are totally gone, and the acid part or Aluminous Spirit of that white mass will also take wing by the increase of the fire, leaving a *caput Mort.* dry, stiptick and as hard as a stone ; yet I account that a pound of this mass, before the fire prefs too much upon it, will go near to afford by Solution, &c. half a pound of tolerable crySTALLIN Allum ; but why this substance should rise so high as the surface of the Earth, though I have some reasons, yet they not being satisfactory to my self, I shall not trouble you with them.

9. *Whether in the places where the Sal armoniac is found, the neighbouring soil be nitrous, or do yield any store of common Salt ?*

Ans.

Ans. The Neighbouring soil differs little from other grounds with us, having neither common Salt, nor Niter in it; for though there be a Salt-well with us, yet it is both on the other side of *Tyne*, and a considerable distance from the fire.

10. *Whether near the places that bear Sal armoniac, there be any Springs that participate of that ingredient or of some other subterranean salt? which will be best known by a slow evaporation, in case one have not the conveniency to do it by distillation, and thereby preserve both the ascending liquor and the Remains, and by then considering the remaining substance, in order to find whether Sal armoniac be impregnated with Mineral bodies not discernable in it by the Colour. And there are some other Mineral Salts, that, though white, are very differing from all the natural Salts that are commonly known, or that I have read of in any Author.*

Ans. I have industriously observed the Springs that are near the Fire, and find none of them that give the least suspicion of *Sal armoniac*. The water that runs from the adjacent Colyeries is vitrioline, giving as deep a tincture with Galls as *Scarborough Spaw*. In a word, it differs nothing from the waters that ordinarily drown our Colyeries, and cost our Coal-owners so much to be quit of them. The other Springs, most of which are dry this year, are of ordinary use, containing no Mineral Salts in them: But I hope you will cease to wonder, that Coal should produce a volatile Salt by the action of fire, seeing I have gathered *Sal armoniac* from a burning Brick-kiln, where nothing but Clay and Coal is burnt together, and I hope none will expect the volatile Salt in the *Sal armoniac* from ordinary Clay. The reason, that first prompted me to seek this Salt there, was, that the Smell of the Kiln did somewhat resemble that of the Subterranean fire. There is also a sort of Mineral we call a *Slate*, which is partly Coal, partly Alumstone, partly *Marcasite*, which being laid up in heaps and burnt, are used for hardening the Coal-ways; upon these heaps, whilst burning, I have often gathered both *Brimstone* and *Sal armoniac*.

As for the Experiment of pouring cold water upon the powdered *Marcasite*, the event was, that it produced a Vitrioline water, but no heat; though I will not deny but the Experiment may succeed better, if more accurately handled by that Noble Philosopher who hath lately been furnished with a considerable quantity of *Marcasites* from my worthy Friend and Associate Dr. *Durant*; a greater quantity of which may be sent if need require; for in
little

little quantities I suppose the Experiment will not succeed.

As to the resemblance betwixt this *Sal armoniac*, and that which comes from Mount *Ætna*, where no Coals are supposed to be ; whence it seems to follow, that our volatile Salt may proceed from somewhat else than Coal. To which difficulty I answer, that when I deduced ours from Coal, I did not exclude other bituminous substances that are analogous to it, of which I suppose the Country, where Mount *Ætna* is, affordeth no inconsiderable quantity; neither will it follow, that no Coals have *been wrought*, therefore there *are none* ; and if trial hath been made, and no Coals found, yet it will be a doubt still, whether those Trials have been sufficient. However it be, yet I think it were not impertinent (by the way) to enquire, whether the sagacious *Venetians* may not be beholden to Mount *Ætna*, or some other Subterranean fires, for the great quantity of *Salarmoniac* they sell to our Merchants: for this Fire affordeth no inconsiderable quantity thereof, especially in dry weather; some of which I have sent by my worthy and honoured Friend Mr. *Richard Gilpin*, who was the person that first brought home part of it from the fire, and in whose company it was first that I experimented it to be *Sal armoniac*; for till then none took notice of it. And I the rather put this trouble upon him, that by him you may be informed in circumstances that would be tedious to relate.

The Box I have sent contains a bottle of the Spirit of this *Sal armoniac* distilled from Quicklime, in which I used a considerable quantity of Spring-water for the dissolution of both the ingredients, before I distilled the Spirit from them.

The great quantity of grey Salt is the *Sal armoniac* as it was gathered from the fire, some of it being six inches broad, and above when it was taken up.

The white Salts in the white papers are the same grey, sublimed *per se* in a Sugar-mold.

The white snowy Salt in the Jar-glass is the volatile Salt of the same, as it comes from the fire. The *Lixivial salt* I used, was only Potashes dissolved in Spring-water; to the whole I added some *Spirit of Wine*, whereby I commonly obtain a greater quantity of volatile Salt in *forma sicca*, than otherwise I could expect.

Now, though it may seem incredible to some, that Black coal should yield so white a volatile Salt, yet they that know that all volatile Salts whatever may be freed from their *fætor* and intense colour,

colour, by transmuting them into a *Sal armoniac* by the mediation of an acid, as *spirit of Salt*, *spirit of Vitriol*, *Alum*, &c. and then subliming them till they be white, will cease to doubt of this matter. The reason of which change, I presume, is, because, though these volatile Salts carry over always some of the fetid oyl with them while in a state of volatility, yet being thus in a manner fixed, the fetid oyl must necessarily by force of fire rise first, leaving the subsequent compound Salt, or *Sal armoniac* without smell; though it is still a doubt, whether the volatile Salt is better or worse for this labour.

As to your Postscript concerning *petrescent Springs*, we have one near us, there is indeed a Cave some miles off, at the furthest end of which few have been; from the roof of which hang large drops of petrified water, like Icles, some of them reaching down to the ground like pillars, these icles are good Limestone, as I have tried.

I shall conclude when I have acquainted you with a Spirit of Sugar, of which a Distiller with us hath a quantity; it seems to be the result of some anomalous fermentation, it is so strong that no man is able to smell at it in an open vessel, without being made almost breathless: neither do I think the person that made it, can make it again. If it prove worth that consideration of the Noble Mr. Boyle, I intreat a brief account of his thoughts concerning it, particularly whether it may be used internally or no, and whether it be a thing ordinary or extraordinary; for in truth I know not what to make of it. If it should prove Antiscorbutick, I hope those will retract their opinion, who deduce the *Scurvy* from the use of Sugar. Sir, Your, &c.

Postscript, *Extracted out of Dr. Hodgson's Letter to Dr. Gi'pin.*

THE Spirit of Sugar, here mentioned, was drawn from bare Sugar-water (which is nothing but the water wherewith the molds, aprons, &c. are washed) fermented with the scum. And it was so exceedingly volatile, that it would not be carried, but lost all its force in the carriage, though it was very well stopped.

An Account of some Books:

Roberti Boyle, *Nobilissimi Angli & Soc. Regiæ dignissimi Socii, OPERA VARIA*; Geneva, in 4^o. 1677.

THE Works of this Noble Author having been already given an Account of in these *Transactions*, at the several times when they came abroad singly; the Publisher, upon the looking over